

Remarks

The amendments to claims 9 and 18 are supported at page 7 lines 12-14 and at page 13 lines 8-9. Claims 8 and 18 have been amended to specify that the prepolymer is isocyanate-terminated, that the prepolymer has an isocyanate content of 0.5 to 35 weight percent, and that the prepolymer is produced from a functionalized oil that has at least 2 hydroxyl groups per molecule on average.

Regarding the Rejections under 35 USC §102(b)/103(a) over Milligan

The examiner is requested to reconsider this rejection in view of the newly amended claims.

Milligan describes reacting fatty acids (not an oil) directly with a polyisocyanate (see ex. 1 and 2), or pre-reacting fatty acids (again not an oil) with a 2,2-di(hydroxymethyl)alkanoic acid, optionally in the presence of another polyol, before reacting with the polyisocyanate (Ex. 3-6).

In neither case does Milligan produce a functionalized oil having an average of at least two hydroxyl groups per molecule, as required by the amended claims. In the first case, no functionalized oil is formed at all. In the second case, the functionalized oil contains significantly less than two hydroxyl groups per molecule. In Milligan's examples 3-6, the hydroxyl functionality can be calculated from the given ratios of starting materials. Those values are from about 1.5 to about 1.7 hydroxyl groups per molecule. Most of the molecules in Milligan's functionalized oils will have only one hydroxyl group.

The hydroxyl functionality of the functionalized oil is very significant. When a fatty acid is reacted directly with a polyisocyanate, as in Milligan's first approach (that used in examples 1 and 2), the fatty acid forms an end group and terminates the chain. This reduces the molecular weights that can be obtained. Similarly, when Milligan produces a functionalized oil that contains an average of 1.5 to 1.7 hydroxyl groups per molecule, that functionalized oil again will react with the polyisocyanate to terminate the chains and limit molecular weight.

Milligan neither teaches nor suggests the specific combination of using (1) tung oil with (2) a polyol having three or more primary hydroxyl groups and a melting temperature of 220°C or less to produce (3) a functionalized oil having an average hydroxyl functionality of 2.0 or more.

Milligan also fails to disclose isocyanate-terminated prepolymers. Because the Milligan's functionalized oils contain mostly species with one hydroxyl group, Milligan's product will mainly be a polyisocyanate that is capped with the functionalized oil. This material will not be isocyanate-terminated and will not be a prepolymer. In Milligan, the isocyanate compound is used "in an amount sufficient to react withal of the active hydrogen-containing components of the reaction mixture, an in some cases a slight excess of that amount". The slight excess is only 5 to 10 percent. This is insufficient to produce a material with the isocyanate contents specified in the amended claims. The slight excess, if used, will tend to produce a minor amount of species that contains one free isocyanate group. Again, this is not a prepolymer.

Milligan's products, therefore, can only cure via the "drying" reaction of the pendant fatty acid groups. The prepolymer of applicant's claims cure via a combination of this drying reaction and an urethane- or urea-forming reaction.

Regarding the rejection under §103(a) over Seiner and Gauerke

Similarly, neither Seiner nor Gauerke, singly or in combination, suggests the specific combination of using (1) tung oil with (2) a polyol having three or more primary hydroxyl groups and a melting temperature of 220°C or less to produce (3) a functionalized oil having an average hydroxyl functionality of 2.0 or more.

Seiner's functionalized oils have hydroxyl functionalities of well less than 2.0. In Seiner's examples, these functionalities are in the range of about 1.25 to about 1.66, as calculated from the types and amounts of starting materials.

Gauerke describes a series of reactions in which glycerol is reacted with an oil and then additional fatty acids to produce a mixed acid glyceride. This product has a hydroxyl functionality of approximately zero. It would not be useful at all for making an isocyanate-terminated prepolymer, due to the lack of hydroxyl groups. Even the intermediate shown in Example I (after reaction of China wood oil and glycol) would have an average hydroxyl functionality of only 1.5.

In addition, neither Seiner nor Gauerke describe isocyanate-terminated prepolymers. In Seiner, the express purpose of this work is to eliminate isocyanate groups. Gauerke of course describes no reaction at all involving a polyisocyanate.

As explained in the current specification, tung oil has highly reactive unsaturation. Because the unsaturation is highly reactive, functionalized tung oils have been very

difficult to produce. This is because the conditions required to transesterify the tung oil with commonly used polyols cause the unsaturated groups of the tung oil to react, causing an increase in product viscosity and a badly discolored product. See page 2, lines 4-12 of the specification. The problem is exacerbated when the functionalized oil has a high hydroxyl functionality, because a greater amount of transesterification is required to produce such a product. What the applicant has found is that this problem can be avoided, if certain polyols are used to functionalize the tung oil. See page 6 lines 15-24 of the specification. The present claims now specify the particular combination of tung oil and a specific class of polyols. This combination is not described or suggested in any of the cited references.

It is therefore believed that the claims as amended define subject matter that is both novel and unobvious over each of the cited references.

Respectfully submitted,  
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